

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A low temperature extrusion process for energy optimized, viscosity adapted micro-structuring of frozen aerated masses, the process comprising the steps of:

locally adjusting a rotational screw speed of an extruder screw;

locally adjusting a mass flow rate of a partially frozen, aerated mass, the mass flow rate adjusted by a positive replacement pump installed at an extruder inlet; and

locally adjusting a cooling temperature at an inner wall of an extruder housing, the cooling temperature adjusted by an evaporation pressure of refrigerant, the process providing having a mechanical treatment of a-the partially frozen, aerated mass over a length of the-an extruder screw channel zone with respect to its local viscosity, performed such that, in each of a subsequent zone there is a dispersing of air bubbles/air cells and at a same time a temperature decrease and related increase of the frozen water fraction is achieved.

Claim 2 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising a characteristic length of the zones into which ~~the-an~~ extruder is divided with respect to an adaptation of a mechanical energy input for ongoing dispersing of air bubbles/air cells and synchronously decreasing temperature or increase of frozen water fraction, being one to tenfold of the outer screw diameter.

Claim 3 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising a characteristic length of the zones into which ~~the-an~~ extruder is divided with respect to an adaptation of a mechanical energy input for ongoing dispersing of air bubbles/air cells and synchronously decreasing temperature or increase of frozen water fraction, being one to tenfold of the outer screw diameter, with a constant length of these zones along the extruder.

Claim 4 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising a characteristic length of the zones into which ~~the an~~ extruder is divided with respect to an adaptation of a mechanical energy input or ongoing dispersing of air bubbles/air cells and synchronously decreasing temperature or increase of frozen water fraction, being one to tenfold of the outer screw diameter with characteristic zone length adapted to the local change of the mass viscosity.

Claim 5 (currently amended): ~~Process according to claim 1~~The process of Claim 1, wherein the adjustment of the ~~comprising an adaptation of the processing parameters~~ rotational screw speed, mass flow rate, ~~adjusted by a positive replacement pump installed at an extruder inlet~~ and cooling temperature at an inner wall of an extruder housing ~~adjusted by an evaporation pressure of refrigerant used for a given extruder screw geometry,~~ are regulated in such a way[[,]] that for a conventional standard vanilla ice cream mass temperature $\leq 11^{\circ}\text{C}$ or more generally a frozen water mass fractions of ~~ea. about~~ $\geq 60\%$ related to the total freezable water fraction are achieved within a first 50–75% of a length of ~~the an~~ extruder measured from ~~the an~~ extruder inlet.

Claim 6 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an adjustment of a mechanical mass treatment with respect to its viscosity in the related extruder zone by adapted variation of the screw channel height.

Claim 7 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an adjustment of a mechanical mass treatment with respect to its viscosity in a related extruder zone by adapted variation of a number of screws.

Claim 8 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an adjustment of a mechanical mass treatment with respect to its viscosity in a related extruder zone by adapted variation of a screw angle.

Claim 9 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an adjustment of a mechanical mass treatment with respect to its viscosity in a related extruder zone by adapted width variation of cuts in a screw flight(s).

Claim 10 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an adjustment of a mechanical mass treatment with respect to its viscosity in a related extruder zone by adjusted pins fixed at an inner extruder barrel wall in such a way that they intermesh with cuts in screw flights.

Claim 11 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an increasing temperature reduction and increasing frozen water fraction along the extruder length due to optimized heat transfer to an evaporating refrigerant contacting an outer wall of an extruder housing by minimizing a leakage gap width between an outer screw flight diameter and an inner extrusion housing diameter.

Claim 12 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising an increasing temperature reduction and increasing frozen water fraction along the extruder length due to optimized heat transfer to an evaporating refrigerant contacting an outer wall of an extruder housing by minimizing a leakage gap width between an outer screw flight diameter and an inner extrusion housing diameter.

Claim 13 (currently amended): ~~Process according to claim 1~~The process of Claim 1 comprising a decreasing mass temperature, related increasing frozen mass fraction and increasing dispersing of a microstructure along the extruder length due to optimized heat transfer to an evaporating refrigerant contacting an outer wall of the extruder housing by generating a flow pattern at an outer front end of a screw flight, which leads to a reduction of the frozen material wall layer thickness not being wiped off by the screw flight(s) smaller than a leakage gap width by adjusting a profile of a screw flight front edge which is incline to an inner barrel wall or rounded with a well defined radius.

Claim 14 (withdrawn): Device for low temperature extrusion process for energy optimized, viscosity adapted micro-structuring of frozen aerated masses having a mechanical treatment of a partially frozen, aerated mass over a length of the extruder screw channel zone with respect to its local viscosity, performed such that, in each of a subsequent zone there is a dispersing of air bubbles/air cells and at the same time temperature decrease and related increase of the frozen water fraction is achieved, having a variable screw geometry along the extruder length locally adjusted according to a local viscosity with respect to efficient progressive dispersing, simultaneous progressive temperature reduction and related freezing of water.

Claim 15 (withdrawn): Device according to claim 14 comprising a leakage gap width between screw flight and inner wall of the barrel of less than 0.1 mm.

Claim 16 (withdrawn): Device according to claim 14 comprising a screw flight thickness between 2 and 20 mm and 1.: screw flight front edge inclination relative to the inner barrel wall of 10-45°, .

Claim 17 (withdrawn): Device according to claim 14 comprising an extruder screw channel height adjusted along the extruder length to mass viscosity whereas in the feeding zone (I) of the extruder the ratio of the screw channel height to the outer screw diameter is preferably adjusted between 0.03 and 0.07, in the middle (length) zone (II) between 0.1 and 0.15 and in the final third of the extruder length between 0.1 and 0.25.

Claim 18 (withdrawn): Device according to claim 14 comprising a continuously increasing screw channel height over the extruder length such that an unscrewed contour line of a screw root between mass inlet and outlet, with the centre length axes of the screw forms an angle of 0.03 to 0.1°.

Claim 19 (withdrawn): Device according to claim 14 comprising screw(s) comprising 3 to 7 screw flights in a first third of the extruder length; with 1-4, screw flights in a second third of the extruder length and with 1-3 screw flights in a final third of the extruder length in the vicinity of an extruder outlet.

Claim 20 (withdrawn): Device according to claim 14 comprising a progressive reduction of a number of screw flights over 2-10 equal or variable length segments of the extruder, whereas the number of screws is continuously reduced by 1-2 screw flights from segment to segment.

Claim 21 (withdrawn): Device according to claim 14 comprising screw angles in an inlet zone (I) between 35 and 90°, in a middle of the extruder between 30 and 45°, and in a final third of the extruder length between 20 and 35°.

Claim 22 (withdrawn): Device according to claim 14 comprising a constant or variable screw angle reduction between 45 and 90° from an extruder inlet zone (I) - to - between 20 to 35° in an extruder outlet zone (III).

Claim 23 (withdrawn): Device according to claim 14 comprising cuts in the screw flights over a first 10 to 30%, of the extruder length.

Claim 24 (withdrawn): Device according to claim 14 comprising screws having more than one screw flight and cuts in the respective screw flights which are shifted axially such that the mass is subjected to scraping/"wiping off" flow at each part of an inner barrel wall.

Claim 25 (withdrawn): Device according to claim 14 comprising cuts in a screw flights where a length of these cuts is 2.5- to 3-fold, of a screw channel height and where the non-cut parts of the screw flights have the same dimensions.

Claim 26 (withdrawn): Device according to claim 14 comprising inbuilt elements connected to an inner barrel wall, intermeshing with cuts in a screw flights during screw rotation.

Claim 27 (withdrawn): Device according to claim 14 comprising elements connected to an inner barrel wall at 2-10 different positions arranged at a perimeter of an inner barrel wall.

Claim 28 (withdrawn): Device according to claim 14 comprising more than one screw flights having cuts in the same axial position to allow for intermeshing with inbuilt elements.

Claim 29 (withdrawn): A single or twin-screw extruder arrangement for low temperature extrusion of frozen, aerated masses and adapted geometry characteristics comprising a mechanical treatment of a partially frozen, aerated mass over a length of the extruder screw channel zone with respect to its local viscosity, performed such that, in each of a subsequent zone there is a dispersing of air bubbles/air cells and at the same time temperature decrease and related increase of the frozen water fraction is achieved, having variable screw geometry along the extruder length locally adjusted according to a local viscosity with respect to efficient progressive dispersing, simultaneous progressive temperature reduction and related freezing of water .